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ABSTRACT

This document gives instructions on how to use a Macintosh computer to create printed materials for mathematics. A Macintosh computer, Microsoft Word, and objected-oriented (Draw-type) art program, and a function-graphing program are capable of producing high quality printed instructional materials for mathematics. Word 5.1 has an equation editor for creating expressions which involve mathematical symbols and constructs such as rational expressions, radicals, matrices, integral and summation symbols, etc. The tables feature facilitates the placement of graphics anywhere on the page. The styles feature supports the creation of documents with uniform appearance. The advantages of object-orientated graphics are discussed and massaging the output of a function-graphing program is illustrated. Different configurations of hardware and software are also presented. (Author/JLB)

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ED 371 733

Creating Printed Materials for Mathematics with a Macintosh Computer

ABSTRACT

A Macintosh computer, Microsoft Word™, an objected-oriented (Draw-type) art program, and a function-graphing program, are capable of producing high quality printed instructional materials for mathematics. This goal of this workshop is to acquaint the user with the following software features and topics.

Word™ 5.1 has an equation editor for creating expressions which involve mathematical symbols and constructs, such as rational expressions, radicals, matrices, integral and summation symbols, etc. The tables feature facilitates the placement of graphics anywhere on the page. The styles feature supports the creation of documents with uniform appearance.

The advantages of object-oriented graphics are discussed, and massaging the output of a function-graphing program is illustrated.

Different configurations of hardware and software are presented.

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AMATYC

BOSTON 1993

Saturday, November 20, 1993

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The Microsoft Word file for this paper, the AMATYC Workshop data file, Graphtoolz, and the Beverly Hills Font are available from the author by sending a 3.5 inch floppy disk.

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Outline

ASSUMPTIONS

User Experience: Basic knowledge of MS Word or some other WYSIWYG mouse-supporting word processor. Experience with creating and saving new documents, opening existing documents, selecting text with the mouse, cutting and pasting.

This workshop cannot make you an expert in any phase of using Microsoft Word. Only long experience and sometimes the availability of a resident expert can accomplish this.

We can hope to show you some of what is possible. You will have to experiment with each new feature for some time to become an expert at that feature. This is the situation with any complex computer application.

Note that experimentation with a product is possible only if you have the manuals available for the software you are using.

Environment:

- MS Word (word processing)
- GraphToolz or Theorist (function graphing utility)
- Superpaint or Canvas (Draw-type graphics program)
- Macintosh with at least four megabytes of memory and Multifinder. Eight megabytes is better.
- A laser printer with the Times and Symbol fonts.

OBJECTIVE

- The creation of short documents mixing text, mathematical expressions, and graphics.

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I. Basics, Styles

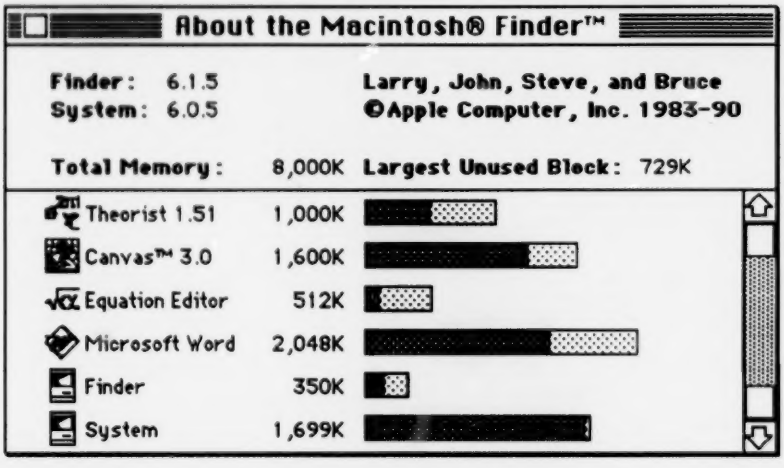
System and Multifinder work environment

You should have at least version 6.0.5 of the System. Some of the most recent products mention 6.0.7. All Macintoshes are now sold with system 7.1.

Multifinder is a Macintosh program which permits you to run several applications at the same time. It is necessary to do any serious work as described in this paper. Thus in system 6 you should run Multifinder, not Finder. System 7 uses Multifinder only.

If you own an older Mac you can accomplish quite a bit by using Finder, Word, and DeskDraw, a Desk Accessory for doing art, by Zedcorps. You would then use the strategy described in the following paragraph for systems with limited memory.

System 7.1 uses over 1 megabyte of memory itself. The diagram below shows my system. You will see that serious work requires at least 8 megabytes of memory. You can get around this by using Word and only one other program at a time. For example you might create all the graphs you need in Theorist or some other program and copy and paste them into your Word document. Then close Theorist and use the Equation Editor to create all labels you will need. Put these into your Word document. Finally, run Canvas (or some other object oriented art program or the DA DeskDraw) and collect these items from Word and massage them in the art program.



It should be clear that if you are going to purchase a Macintosh you need to buy at model which supports at least 8 megabytes of memory, and you need to purchase it with at least 4 megabytes installed.

If you are going to do a lot of text creation I also recommend a full page screen display. If price is no object buy at least 16 megabytes of installed memory and a two page screen display. You'll be glad you did. This configuration would allow you to see all of your application windows at once. (Don't say you cannot afford it – just buy a cheaper car next time!)

Some Symbols and Conventions

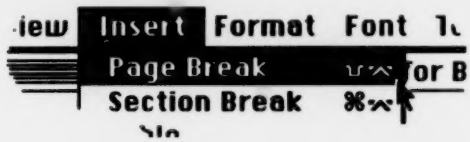
⌘	Command Key
⌅	The *enter* key (on the numeric keypad).
⌥	The *option* key.
⇧	The *shift* key.
␣	The space bar.
¶	Paragraph; entered by using the *return* key.
↵	Soft return, or new line. Created by holding down the shift key while hitting the return key. This starts a new line without starting a new paragraph.
⌨	The numeric keypad.

☞ In older versions of Word you must select **Edit:Full Menus** to use Word's more advanced features.

Menu convention and Keystroke Equivalents

If we write **Insert:Page Break** we mean the Page Break command which is located in the Insert menu. The menus were changed in version 5.0 and will change again in version 6.0. We use the Chicago font since this is what the default system font is on the Macintosh.

Observe what the menu item for Page Break actually looks like as shown in the figure at the right. The ⇧↩ after the command title means that this command can be activated by using the SHIFT+ENTER key as well as by using the Insert menu. Most common Word commands can be activated by either a menu or keystroke.



Font

I generally recommend Times 12 as your standard font. This is assumed throughout this document.

Super/Subscripts

Superscripts are created by entering ⇧⌘+ first. Subscripts are created by entering ⇧⌘– . To return to normal text select **Format:Revert to Style** ⌘⇧Space.

Exercise 1: Create a new document and type in the text "$y_1 = 3x^4 + 2x^3 - 7$".
Use the return key to start a new line.
Now type in "x = " then "⌘⌥\" (hold down the command and option keys, then enter \), then enter "f(1,2)". You will have entered the fraction $\frac{1}{2}$ using Words Mathematical Formulas feature. You should see $x = \frac{1}{2}$ on the screen. Don't close or throw away this scratchpad document. Just leave it on the screen.

Viewing Modes

There are several ways in which to view a document. You can edit a document in those modes listed under editing. Print Preview (under viewing) is not normally used for editing, but in fact it is the only mode in which you can move frames around. We do not discuss frames in this document.

Editing: { **View:Normal** / **View:Page Layout** / **View:Show ¶** } Viewing: **File:Print Preview...**

Note that the show paragraph (**Show ¶**) mode can be selected either in Normal or Page Layout mode. In computer parlance the show paragraph mode is orthogonal to (cuts across) these other two modes.

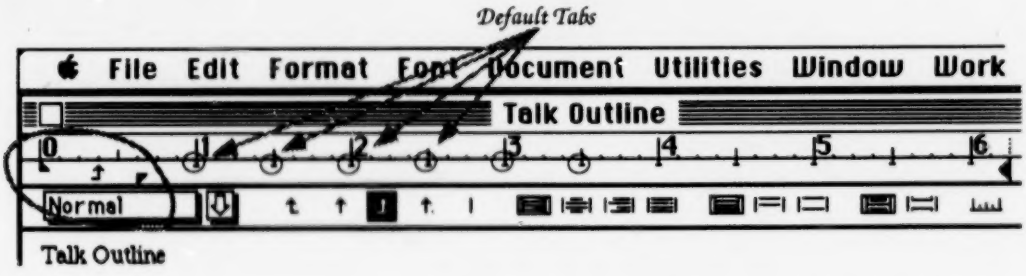
Exercise 2: In the scratchpad document you created select normal view and then select show paragraph. Observe that the appearance of the fraction $\frac{1}{2}$ becomes \f(1,2). Select all of the characters which describe the fraction and reduce the font size to 10. The fraction will look like $\frac{1}{2}$, which is probably better for most purposes.

Text Alignment Always use tabs — *never space using blanks.*

Styles

Styles are a way to format a particular paragraph and then give that paragraph's format a name. The same style can then be applied easily to other paragraphs using this name. For example, a simple style for test questions would have tabs and paragraph margins as shown in the figure[1].

Styles can be defined for paragraphs only. Paragraphs are one or more lines terminated by the normally invisible paragraph marker ¶. This marker is visible in the show paragraph (**View:Show** ¶) mode.



1. (This and the following paragraph are formatted this way). This format allows neat problem numbering by placing a tab in front of the number. Long lines will automatically line up, as they do in this paragraph. Use a soft return ↵ when it is necessary to start new lines and you still want to stay in the same paragraph.

   This and the previous line were started with a soft return. This could be seen by opening the file for this document and selecting the **View:Show** ¶ mode.

2. This paragraph-oriented format can be put into a style using **Format:Style...**; this process is illustrated in exercise 3.

Exercise 3: Open the file called *AMATYC Workshop Data*.
Copy the first paragraph to your scratchpad document.
Create a style called *One Question* in the scratchpad document as follows:

- Place the cursor anywhere in the paragraph you copied into the scratchpad document.
- Format this paragraph with the margin and tabs as shown in the figure above. To do this open the ruler (use **View:Ruler**) if necessary. To move the lower part of the left margin marker without moving the upper part hold down the shift key while using the cursor to select and move the lower part. Note that the tab is a right-justify tab (┘), not the default left-justify tab.
- Select **Format:Style...**.
- Enter the name of the style: One Question.
- Select the **Define** button.
- Close the window (click in the empty box in the upper left corner of the window).

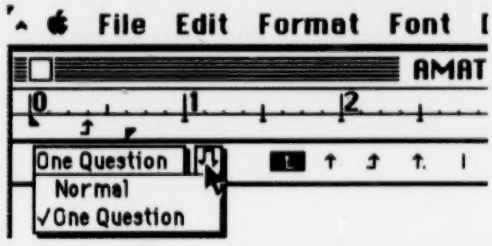
The paragraph should look like the following, but without the outline border (which is done with **Format:Border...** in case you are interested.

1. The function $f(x) = \sin(x) + \frac{1}{3}\sin(3x) + \frac{1}{5}\sin(5x)$ is the first three terms in the *Fourier series* for a square wave. As more and more terms are added to the expression which defines the function, the graph approaches the square wave shown in the figure. The function is formally defined as $f(x) = \sum_{i=0}^{\infty} \frac{1}{2i+1}\sin[(2i+1)x]$. The fact that one cannot actually add up an infinite number of values is a nicety which mathematicians have circumvented with the concept of limit.

[1]Some figures were created with Word 3.0, so their appearance may not be identical to that of the latest version of Word.

Now apply the One Question style to the long paragraph about the Pythagorean theorem (paragraph 2) as follows.

- Copy paragraph 2 from the *AMATYC Workshop Data* document into your scratchpad document.
- Place the cursor anywhere in this paragraph.
- Select the One Question format from the ruler as shown in the figure at right.
- Number the "question" by putting a number at the beginning of the paragraph. Precede the number by a tab. Follow the number with a '.' and a tab.



II. Text Format

Variables Variables should be in italics.

Symbol for Negation and Subtraction

The conventional "-" (hyphen) is terrible for subtraction. Use "–" (⌥ –, called "em dash") instead. (Drawback: Word's built-in calculating capability does not recognize the em dash as signifying a negative value. The Equation Editor also does not recognize the em dash when text is pasted into it, even though that is the character it uses itself!)

Exercise 4: In the scratchpad document type in the text "$y_1 = 3x^2 - 2x - \frac{1}{2}$". Use the em-dash for subtraction.

Text Sizes/Vertical Offsets/Line Spacing

The size and vertical offset of super- and subscripts affects the appearance of mathematical expressions. The default settings may not be acceptable. Some different settings are illustrated here. The normal text size is 12 points in all cases.

$x^5 - 3x^4 + 2x^2 - x - 3$ { DEFAULT SETTINGS, 3-point superscript offset, 10 point superscripts, usual minus, normal text variable.

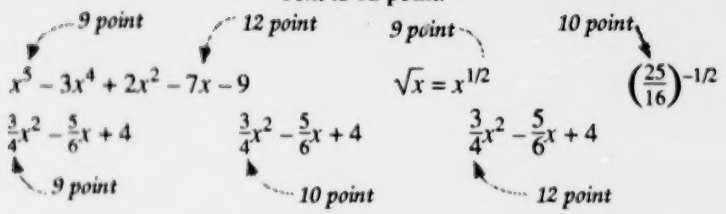
$x^5 - 3x^4 + 2x^2 - x - 3$ { 5-point superscript offset, 9 point superscripts, em dash, italicized variable.

$x^5 - 3x^4 + 2x^2 - x - 3$ { 5-point superscript offset, 10 point superscripts, em dash, italicized variable.

$x^5 - 3x^4 + 2x^2 - x - 3$ Equation Editor (discussed in part III below)

The following graphic illustrates the effects of using the values mentioned above for text and superscripts, and of various sizes for fractions.

Text is 12 point.



Text line spacing is normally autospaced, but it may look better if a fixed line spacing is used. Right justification is also helpful when paragraphs are not too wide. The following illustrates this. All of this also depends upon how complicated the mathematical expressions in the text are.

TEXT	SPACING
We will format this paragraph using a fixed line spacing. We all know that the Pythagorean Theorem states that $a^2 + b^2 = c^2$, where a, b, and c are the lengths of the sides of a triangle. We also know that the fraction $\frac{1}{2}$ is the same as the decimal fraction 0.5. It is also true that $\sqrt{a^2} = a$ if $a \geq 0$. We will format this paragraph using the One Question style. We all know that the Pythagorean Theorem states that $a^2 + b^2 = c^2$, where a, b, and c are the lengths of the sides of a triangle. We also know that the fraction $\frac{1}{2}$ is the same as the decimal fraction 0.5. It is also true that $\sqrt{a^2} = a$ if $a \geq 0$. We will format this paragraph using the One Question style. We all know that the Pythagorean Theorem states that $a^2 + b^2 = c^2$, where a, b, and c are the lengths of the sides of a triangle. We also know that the fraction $\frac{1}{2}$ is the same as the decimal fraction 0.5. It is also true that $\sqrt{a^2} = a$ if $a \geq 0$.	*auto*
We will format this paragraph using a fixed line spacing. We all know that the Pythagorean Theorem states that $a^2 + b^2 = c^2$, where a, b, and c are the lengths of the sides of a triangle. We also know that the fraction $\frac{1}{2}$ is the same as the decimal fraction 0.5. It is also true that $\sqrt{a^2} = a$ if $a \geq 0$. We will format this paragraph using the One Question style. We all know that the Pythagorean Theorem states that $a^2 + b^2 = c^2$, where a, b, and c are the lengths of the sides of a triangle. We also know that the fraction $\frac{1}{2}$ is the same as the decimal fraction 0.5. It is also true that $\sqrt{a^2} = a$ if $a \geq 0$.	*Exactly 16* *Right justified*

Exercise 5: Copy the third (Pythagorean theorem) paragraph in the AMATYC Workshop Data document into your scratch document. Apply fixed 14 point spacing to this paragraph. Do this via the **Format:Paragraph...** dialog box. Change Line (spacing) from Auto to Exactly 14 point.

Exercise 6: Modify the One Question style to fixed (exact) 14 point line spacing. Do this as follows.

- Select **Format:Style...**
- Select the One Question style (darken it in)
- Select **Format:Paragraph...** and change line spacing to exactly 14 points.
- Select OK to accept these changes and close the format paragraph window.
- Select Define in the format style window. Then close the window (small box in upper left corner

The Symbol font

It doesn't hurt to know what characters are available in the symbol font. They are presented here for your information. Also, if you enter ⌘⇧q then the next character typed will be in the symbol font. This is an easy way to get Greek letters in a text. For example to type sin α = 0.5 enter "s i n ⌘⇧q a = 0.5".

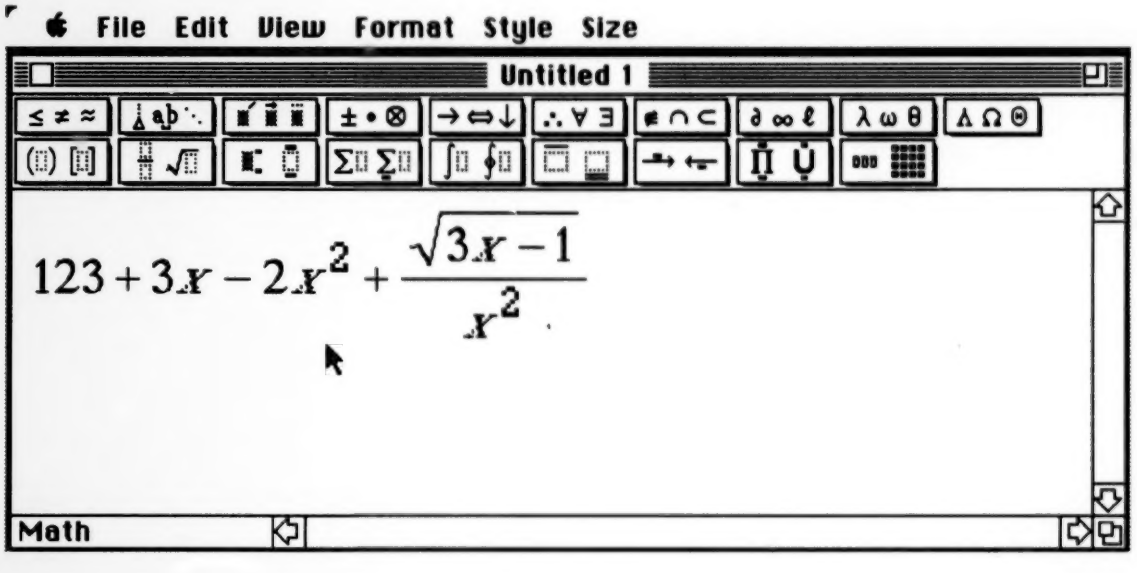
The SYMBOL Font	
1 2 3 4 5 6 7 8 9 0 ∠ = θ ω ε ρ τ ψ υ ι ο π [ ] α σ δ φ γ η φ κ λ ; ϑ ζ ξ χ ϖ β ν μ , . / ∴	! ≡ # ∃ % ⊥ & * ( ) − + Θ Ω E P T Ψ Y I O Π { } A Σ Δ Φ Γ H ϑ K Λ : ∀ Z Ξ X ς B N M < > ? |
ℑ ♠ ≤ ′ ° / ƒ ∞ ≈ … ∠ ↑ ∉ • ↔ ♦ × ← ⊥ ↵ ≠ ® ™ ♣ ∂ ⊗ ♥ | ∅ ⌋ ℜ ⊃ — | ⊕ ℘ ≡ ~ ∝ ″ ≥ √ ¯ ∩	∨ ⇔ ⇐ ⇑ ⇒ ⇓ ◊ ϒ 〈 ® ∀ ± ∈ © ™ ∑ ⌠ | ⌡ ⌈ ↓ + © ∏ | ⌊ ⌈ { ⌊ | ⌘ 〉 ∫ → ⌈ | · ⌋ ⌉ | ⌋ ⌉ ℵ ∧ ∪

III. The Equation Editor

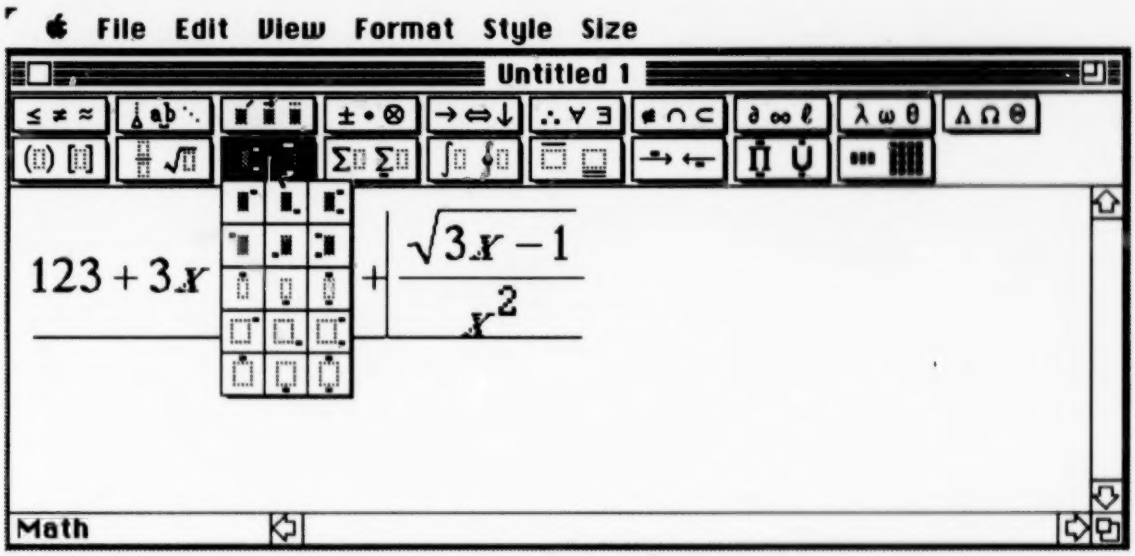
The best way to create mathematical expressions and statements is with the Equation Editor. This has been available with Word since version 4. One result of using the editor is shown above in part II under "Text Sizes/Vertical Offsets/Line Spacing". Using this editor is fairly natural after trying it a bit.

A word of warning. *You need to decide on the font and font size for your text before using the Equation Editor.* It is a lot of work to go back and change each equation in a long document.

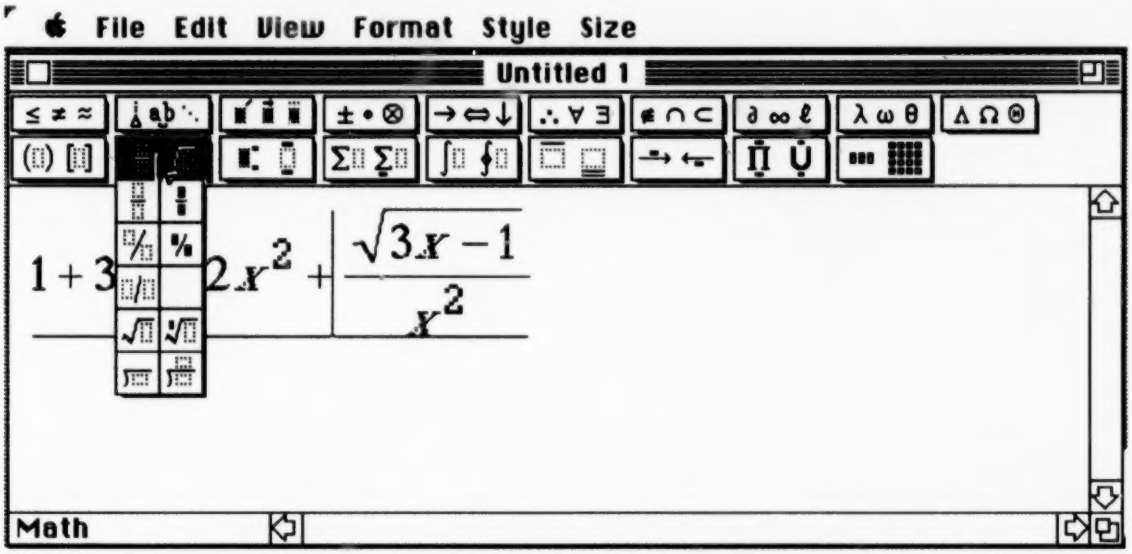
You should launch the Equation Editor if you have not already done so. It is in the Word commands folder in the MS Word 5.1 folder on the desktop.



The following figure shows how a superscript or subscript is created. To enter an exponent one selects the box which looks like $\square^{\square}$ after typing the base and before typing the exponent. Then use the tab key to exit this superscript mode.



The following figure shows what to select before entering a rational expression or radical. The open box symbol $\frac{\square}{\square}$ gives a rational expression in which the font is normal size. The closed box symbol $\frac{\square}{\square}$ reduces the size of the font in the numerator and denominator.



I like to open the Equation Editor as a separate application in its own window and keep it open between use. This makes it very easy to go back and forth between the Equation Editor and Word.

Exercise 7: Use the Equation Editor to create the following expression: $123 + 3x - 2x^2 + \frac{\sqrt{3x-1}}{x^2}$.

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Exercise 8: Create the following text item in your scratchpad document. Use the One Question format. Type "12. Factor the expression", then create $3x^2 - 3x - 18$ with the Equation Editor, copy it and paste it into the Word document. Then type "completely."

> 12. Factor the expression $3x^2 - 3x - 18$ completely.

Exercise 9: Create the following expressions and statements using the Equation Editor. Try those marked with ❖ during the workshop.

❖1. $\dfrac{\frac{1}{3}+\frac{1}{2}}{\frac{1}{3}-\frac{1}{2}}$

2. $\dfrac{xy+3y}{xy-3y} = \dfrac{x+3}{x-3}$ if $y \neq 0$.

3. $\dfrac{\frac{x-1}{x}}{\frac{x+1}{2x}} = \dfrac{2(x-1)}{x+1}$ if $x \neq 0$.

Note: It is possible to type non-italicized text in the Equation Editor by selecting **Text** in the **Style** menu.

4. $\sqrt{7}$

5. $\sqrt[3]{7}$

6. $\dfrac{\sqrt[3]{7}}{\sqrt[3]{7}-1}$

7. $\sqrt{\dfrac{2x-1}{x^2-3}}$

8. $\sqrt{x^2} = x$ if $x \geq 0$.

❖9. If $\dfrac{\sqrt{y-3}}{3} = 8$, then $y = 579$.

10. If $ax^2 + bx + c = 0$ and $a \neq 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

11. $\left(\dfrac{x}{x+1}\right)$

❖12. $\left|\dfrac{x}{x+1}\right|$

13. If $ax^2 + bx + c = 0$ and $a \neq 0$, then $ax^2 + bx + c = a\left(x - \dfrac{-b+\sqrt{b^2-4ac}}{2a}\right)\left(x - \dfrac{-b-\sqrt{b^2-4ac}}{2a}\right)$.

14. $\left(\dfrac{x}{x+1}\right)^3$

❖15. $\begin{pmatrix} 2 & 1 & 3 \\ 1 & 0 & 22 \\ 9 & 31 & 15 \end{pmatrix}$

16. $\begin{bmatrix} 1 & 2 & 3 & 9 \\ 0 & 5 & 8 & 26 \\ 0 & 0 & \frac{31}{5} & \frac{62}{5} \end{bmatrix}$

17. The symbol ${}_{10}C_4$ is also written $\binom{10}{4}$.

18. $\begin{pmatrix} \lambda - 1 & 0 & 0 \\ 0 & \lambda - 3 & 0 \\ 0 & 0 & \lambda - 2 \end{pmatrix}$

19. $\int_1^9 x^2 dx$

20. $\sum_{i=1}^{50} (i^2 + 3)$

❖21. $\sum_{i=1}^{50} \dfrac{i}{i^2+3}$

22. $\int_a^b \int_c^d f(x,y)dxdy$

23. $\operatorname{erf}(x) = \sqrt{\frac{2}{\pi}} \int_x^\infty e^{-\frac{1}{2}t^2} dt$

BOXES

Use the formula command "\x(something-to-put-in-a-box)". Remember that \ is ⌘⇖\.

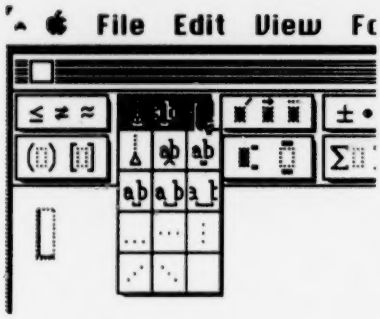
Example: To calculate $\dfrac{2+8}{2}$ enter [(] [2] [+] [8] [)] [÷] [2] [=]. Note: [(] [2] is \x(\() \x(2).

Exercise 10: Replicate the text in the example above.

LONG DIVISION

Long division is a lot of work. It can be done as a graphic or with the Equation Editor. The figure shows an Equation Editor tool which can be used to enter a blank space of vary-ing width to line up columns.

The long division at the far right was created with the Equation Editor.



$$\begin{array}{r} 587 \\ 21\overline{)12345} \\ \underline{105} \\ 184 \\ \underline{168} \\ 165 \\ \underline{147} \\ 18 \end{array}$$

The following illustrates the only way I have found to set up a long division problem for polynomials with high quality alignment of the terms. It uses a table. (If you are viewing this document on a computer use use **View:Page Layout**.)

$$\begin{array}{r} x^2 - 3x + 5 \\ 2x + 1 \;\overline{)}\; 2x^3 - 5x^2 + 7x + 5 \\ \underline{2x^3 + x^2} \\ -6x^2 + 7x + 5 \\ \underline{-6x^2 - 3x} \\ 10x + 5 \\ \underline{10x + 5} \end{array}$$

						x^2	−	$3x$	+	5
$2x$	+	1	)	$2x^3$	−	$5x^2$	+	$7x$	+	5
				$2x^3$	+	x^2				
					−	$6x^2$	+	$7x$	+	5
					−	$6x^2$	−	$3x$		
								$10x$	+	5
								$10x$	+	5

Exercise 11: Use your imagination to figure out a way to create "$|x| = \begin{cases} x \text{ if } x \geq 0, \\ -x \text{ if } x < 0 \end{cases}$" with the Equation Editor.

IV. Graphics

Graphics should be created by an object oriented (draw) program, not a bit-pattern paint program. I use GraphToolz or Theorist for graphs, Superpaint or Canvas for graphics.

We look at two issues which apply to graphics in a text document: Mixing text and graphics, and placement of graphics on the page.

Mixing Text and Graphics

Add graphics to text.

Special effects on text can be effected by creating the desired mathematics expressions in the Equation Editor and then copying the text into a graphing program. This is illustrated here.

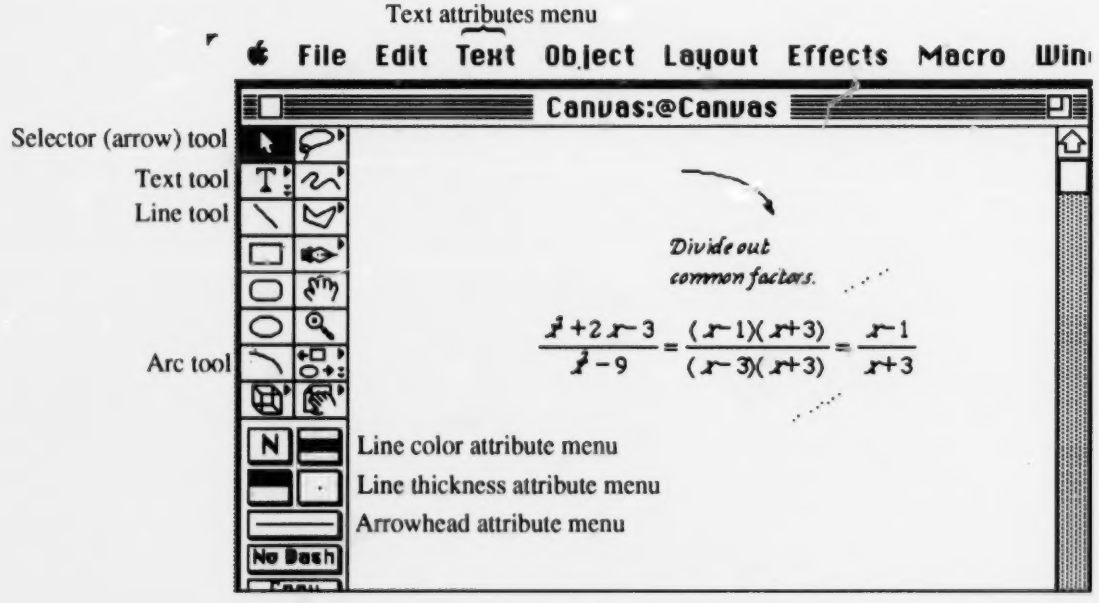
TEXT: $\dfrac{x^2+2x-3}{x^2-9} = \dfrac{(x-1)(x+3)}{(x-3)(x+3)} = \dfrac{x-1}{x+3}$

Divide out common factors.

Reduce: $\dfrac{x^2+2x-3}{x^2-9} = \dfrac{(x-1)(x+3)}{(x-3)(x+3)} = \dfrac{x-1}{x+3}$

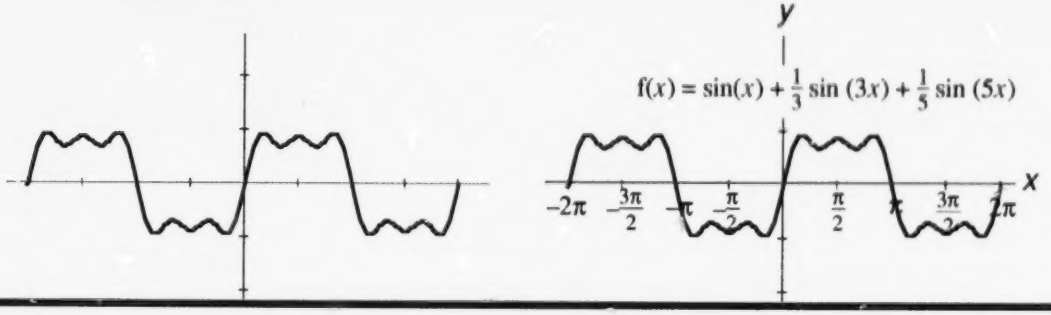
Exercise 12: Create the effect shown in the box on the previous page. Do this as follows. (Refer to the diagram below also, which is of the art program Canvas.)

1. Create the statement shown in TEXT above with the Equation Editor.
2. Start up an art program – we'll use Canvas. (Don't quit from Word or the Equation Editor.) Copy this text from the equation editor into the art program.
   Note: If there is not enough memory to run the Equation Editor and the art program, copy the text into your Word document (anywhere will do) and close the Equation Editor. Then if necessary you can retrieve the text from your Word document when necessary.
3. Paste the text into a new Canvas document.
4. Create the label "Divide out common factors" in Canvas. Use the text tool and any conven-ient font (I used Zapf Chancery). Use the text attributes menu to obtain the font you want.
5. Use the arc tool to create a curved line for the arrow. Select the line with the selector tool and use the Arrowhead attribute menu to put an arrowhead on one end.
6. Use the Line tool to create the slashes for crossing out the common factors. Select each with the selector tool and use the line thickness attribute menu to set the thickness to 3 by 3, and the line color attribute menu to make each a 10% gray shade.
7. Use the selector tool to position all these ingredients into the desired graphic. Select all the objects (one way is with the **Edit:Select All** command) and copy them.
8. Return to the Word program.
9. Type the word Reduce: on a new line, then paste what you just copied from the art program. The art will not line up well with the word Reduce:.
10. To line up the graphic and the word Reduce, select the graphic and open the **Format:Character...** box. Select the **Position:Subscript** item and adjust the subscript value appropriately. (A setting of 10 or 12 is probably correct). The best value can be found by selecting **Apply** to see the effect of a subscript value before you actually close the window.



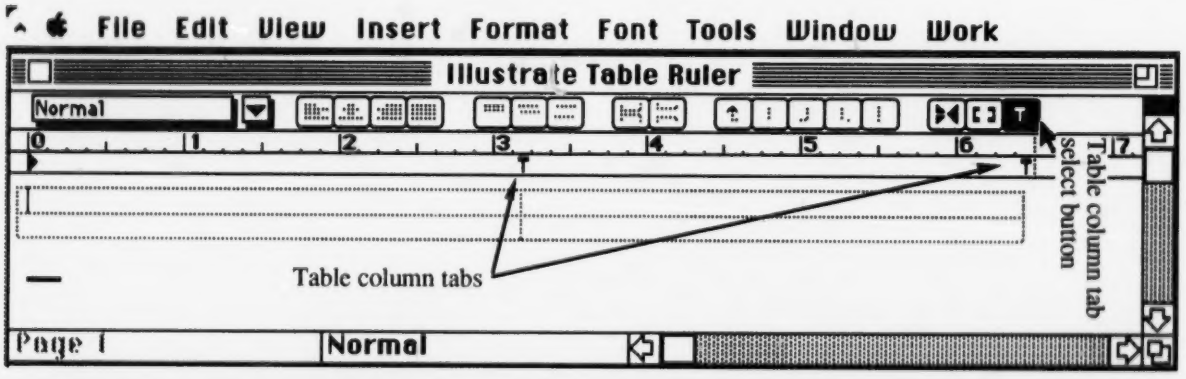
Add text to graphics. Specifically, add labels to graphs of relations.

Exercise 13: Add labels to the graphic (left) below so it appears like the finished product on the right. Do this by creating the text with the Equation Editor. Then copy the unlabeled graphic to the graphic program. To save time the graphic and the text can be found in the AMATYC Workshop Data file. Put all of this in the scratch document you originally created (or anywhere you want).
A way to save time cutting and pasting is to select all of the text and the graphic in Word at the same time, then use the **Copy as Picture ⌘⌥D** command. This command basically takes a picture of whatever is selected in Word, but items separated by tabs are copied as separate graphic items.



V. Tables — Positioning Graphics in Text

Simple Positioning of graphics opposite text can be done with a table of one row and two columns. This is created with **Insert:Table...** . Text can be put in one of the columns and a graphic in the other. The width of the columns can be changed in the ruler as shown in the figure. To see the column width tabs click on the table column tab select button (see the figure below. *Make sure the cursor is inside of the table.*) Moving the tabs changes the column widths for all rows which are currently selected. To move just one tab hold down the shift key while moving the tab.



Exercise 14: In the AMATYC Workshop Data Document is a paragraph (about a Fourier Series) and a graphic. Put the graphic on the right side of the text by proceeding as follows.

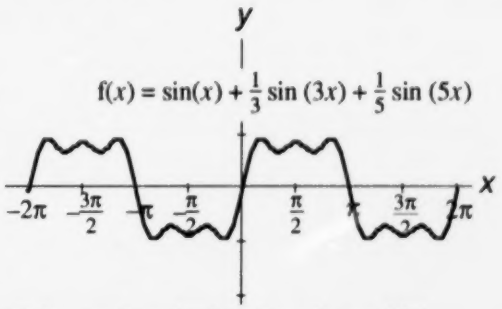
- Select both the text and the graphic. Make sure you do not select any other paragraphs. Copy and paste this all into your working document. Reselect the text and graphic.
- Select **Insert:Text to Table...**.
- Within the resulting window select the **Convert from Paragraphs** option. Select 2 columns and one row. Then select the **OK** button.

It is a good idea to be able to see the table gridlines (outlines which do not print). One way to do this is in **Tools:Preferences...**/View. Check the table gridlines box.

•Experiment with adjusting the width of the columns as described above. Put the text in the One Question format we created earlier.

•Try to make your text look like that below. (The solution is not elegant. If you cannot figure out how to do this, look at the file for this document with the table gridlines visible.)

1. The function $f(x) = \sin(x) + \frac{1}{3}\sin(3x) + \frac{1}{5}\sin(5x)$ is the first three terms in the *Fourier Series* for a square wave. As more and more terms are added to the expression which defines the function, the graph approaches the square wave shown in the figure. The function is formally defined as $f(x) = \sum_{i=0}^{\infty} \frac{1}{2i+1}\sin[(2i+1)x]$. The fact that one cannot actually add up an infinite number of values is a nicety which mathematicians have circumvented with the concept of limit.



The layout below was done by creating a two row by two column table. Then the two cells in the top row were selected and merged using **Format:Table Layout...** . The outlines were created using the **Format:Border...** command.

Graph the parabola $f(x) = x^2 - 3x - 9$.

$f(x) = x^2 - 3x - 9$

$= x^2 - 3x + \frac{9}{4} - 9 - \frac{9}{4}$ Complete the square

$= \left(x - \frac{3}{2}\right)^2 - \frac{45}{4}$

Vertex: $(1\frac{1}{2}, -11\frac{1}{4})$

Intercepts:

x = 0: $f(0) = 0^2 - 3(0) - 9 = -9$ $(0, -9)$

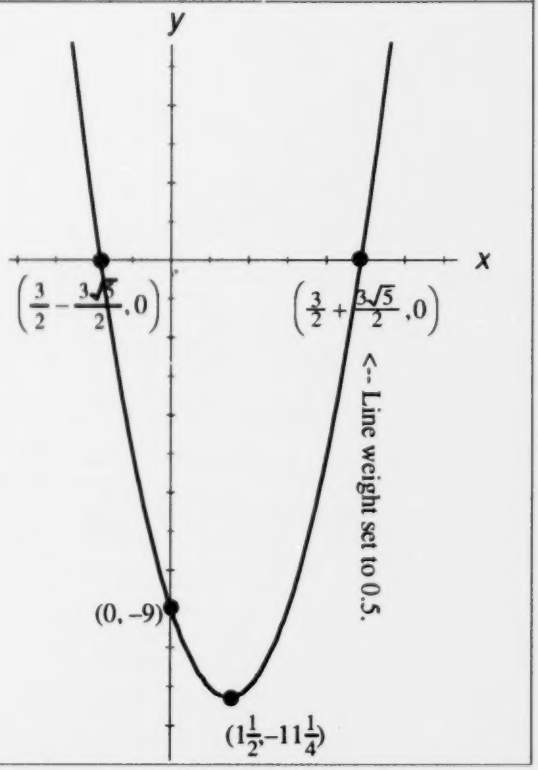
f(x) = 0: $0 = (x - \frac{3}{2})^2 - \frac{45}{4}$

$(x - \frac{3}{2})^2 = \frac{45}{4}$

$x - \frac{3}{2} = \pm\sqrt{\frac{45}{4}}$

$x = \frac{3}{2} \pm \frac{3\sqrt{5}}{2}$ $\left(\frac{3}{2} + \frac{3\sqrt{5}}{2}, 0\right), \left(\frac{3}{2} - \frac{3\sqrt{5}}{2}, 0\right)$

Note that all four ordered pairs for the *x*-intercepts were created with the Equation Editor. However their appearance is different when placed in a graphic. For best results it is necessary to select the Equation Editor graphic and set the line weight narrower. In Canvas I use 0.5. Note the difference in the left and right *x*-intercept labels in the graphic.



Frames

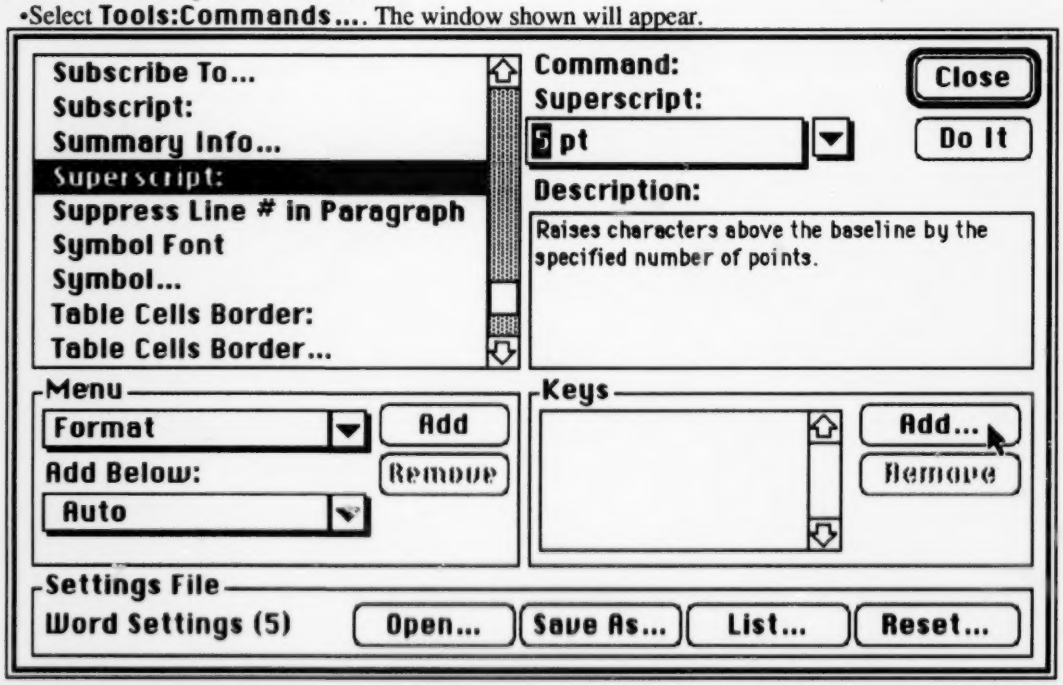
Another way to position a particular graphic or paragraph on a page is with the **Insert:Frame...** command. This is only of limited usefulness for your most likely purposes because moving around the graphic can easily upset text which you have carefully lined up with tabs, as often happens with mathematics oriented material. We will not pursue this topic here.

VI. Customizing the Word environment

Adding/Deleting/Changing Commands

The **Tools:Commands...** feature allows one to customize menus and even the effect of some commands. Since I prefer exponents to be 5 points up, not 3 points, I changed the superscript command ⇧ ⌘ + to give a 5 point offset. To do this, proceed as follows.

•Select **Tools:Commands...**. The window shown will appear.



•Find the **Superscript:** entry, as shown type ("su" to get close). Change the **3 pt** to **5 pt** by selecting 3 and typing 5, as shown. Then select **Add...** to a menu or to a key, as shown by the cursor in the figure. It should make sense that to define this command you must add a key command to it or put it in a menu. Otherwise it would be inaccessible.

•A dialog box will ask you to type in the keys for this command. Type ⇧ ⌘ + , which is the normal command for exponents. The dialog box will query whether it is all right to delete these keys from the 3 pt superscript command. Say yes (assuming you want this, of course!).

•Select the Close button to close the window.

From now on ⇧ ⌘ + will produce a five point offset for exponents. Note that this setting can always be customized for any particular selection with **Format:Character...** .

Observe that this window permits customizing menus. Commands may be added to or deleted from menus in the **Menu** section, and keys may be defined and redefined to represent commands, whether or not they are in a menu, in the **Keys** section. Just make sure you never remove the **Commands...** command from the **Tools** menu!

Exercise 15: Add **Copy as Picture** to the **Edit** menu.

I have found it useful to add the following commands to the menu indicated.

Edit:Copy as Picture
Edit:Go Back

Tools:"Smart" Quotes

View:Show Hidden Text
View:Show Picture Placeholders
View:Show Table Gridlines
View:Show Text Boundaries

The Glossary

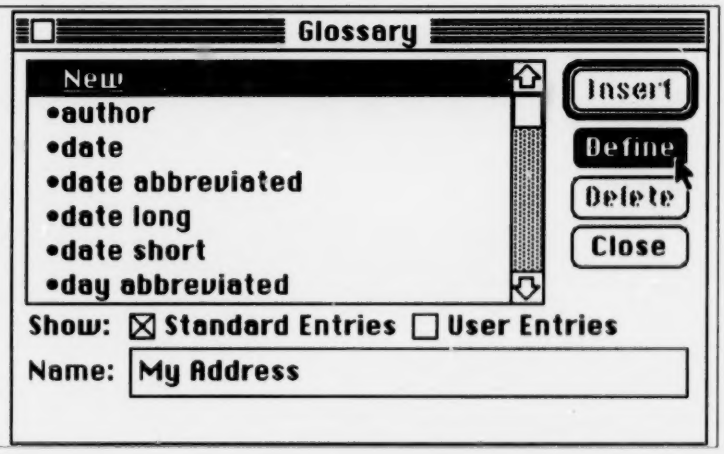
Any chunk of text which you use repeatedly can be put in the glossary. Any glossary entry can be added to the Work menu. (The Work menu is not shown until an item is put into it.)

By way of example, suppose you wish to use a template for your name and address. We could create one and put it into the Work menu as follows. (Exercise 16 below suggests that you try this yourself).

•Type out the template. Assume it is as shown in the box:

Philip Mahler
Department of Mathematics
Middlesex Community College
Springs Road
Bedford, MA 01730

•Select the text for the template.
•Select **Edit:Glossary...** .
•Type in the name: "My Address" (see the figure at the right)
•Select **Define**.
•Close the glossary window.



From now on this template can be obtained from the glossary by opening the glossary, selecting this entry, and selecting **Insert**.

The Work Menu

If you will be using a particular command or glossary entry often it can be added to the Work menu. (This menu is not shown until it has at least one entry).

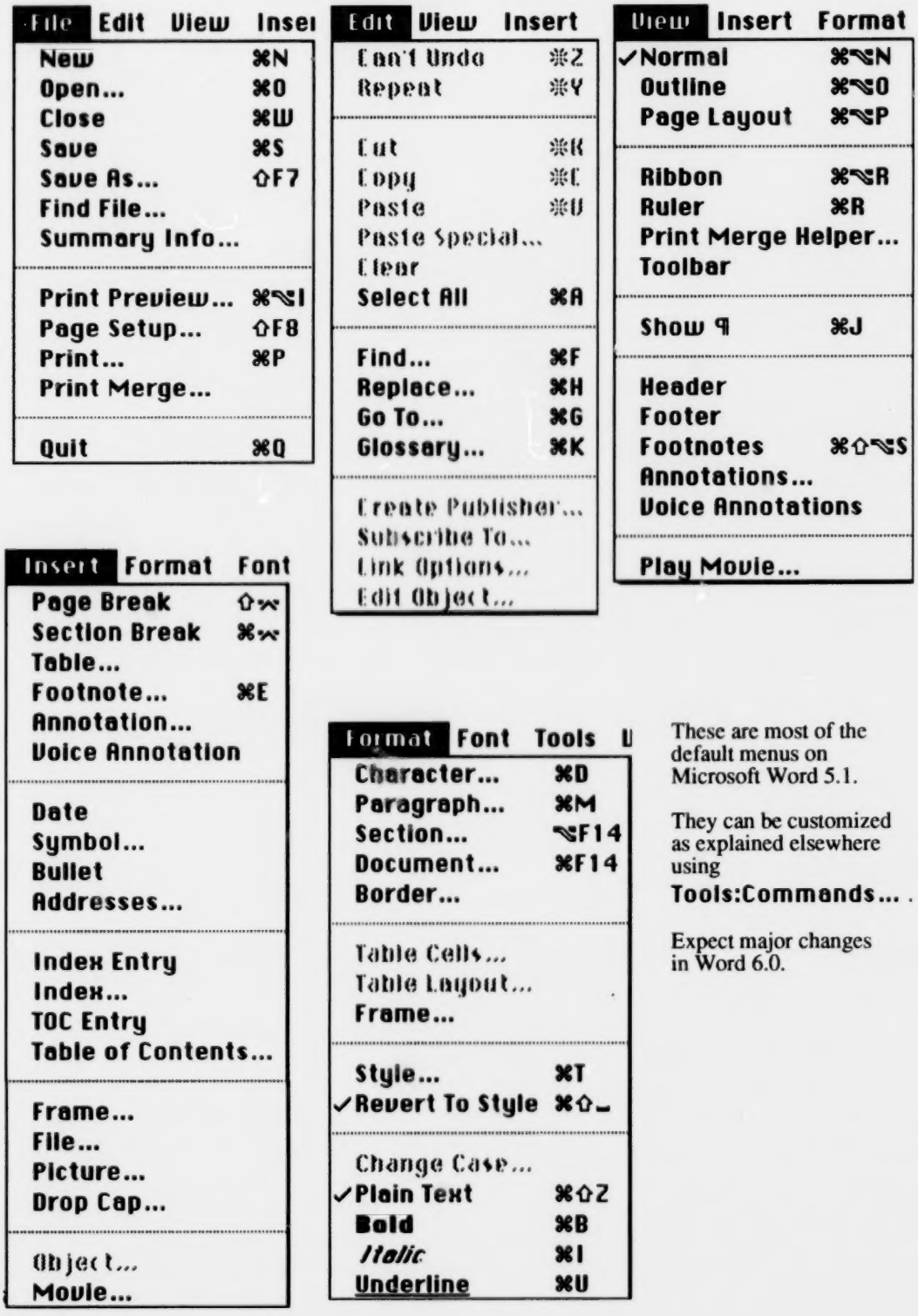
This new glossary entry from above can be added to the Work menu as follows.

•Open the **Tools:Commands...** menu.
•Select **Glossary Entry:**.
•Select **My Address** by moving through the **Glossary Entry:** menu.
•When this entry is showing, select **Add** under **Menu**.
•Exit by selecting **Close**.

From now on the Work menu will appear, and this glossary entry can be inserted into a document by selecting this item in the Work menu.

Exercise 16: Create a glossary entry for your own name and address. Then add this glossary entry to the **Work** menu.

Initial Menus in Microsoft Word 5.1



These are most of the default menus on Microsoft Word 5.1.

They can be customized as explained elsewhere using **Tools:Commands...** .

Expect major changes in Word 6.0.

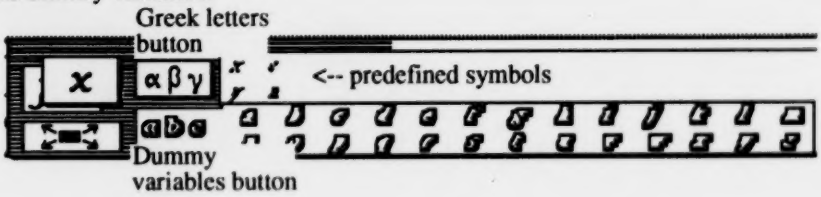
VII Using Theorist to create a graph

Theorist is a symbolic algebra program. There may be more powerful programs (Mathematica or Maple for example) but Theorist makes mathematical expressions look like we expect, not like a computer program.

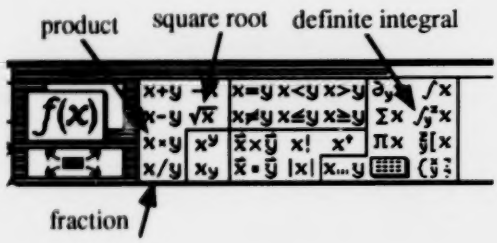
By way of example we will show how to graph $y = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$.

Open the Theorist application. It will create a new "notebook" for you.

Theorist has two palettes at its top. They are shown in the following two figures. You toggle back and forth between them by clicking in the $f(x)$ or x box. One is for selecting functions and operators and the other is for selecting Greek and dummy variables.

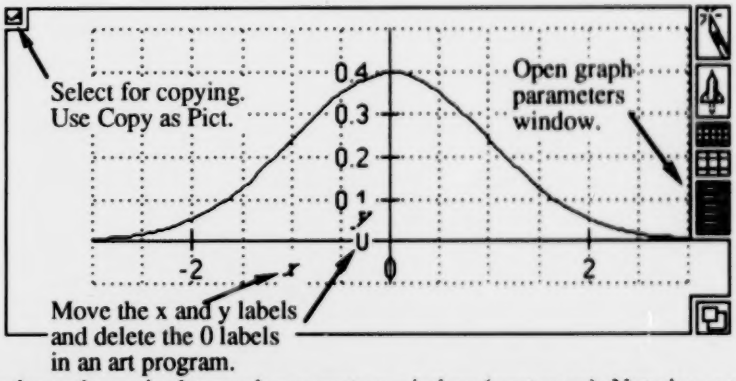


Type in the statement $y = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$. It takes a little trial and error. The following lines are a guide. They refer to the $f(x)$ menu.



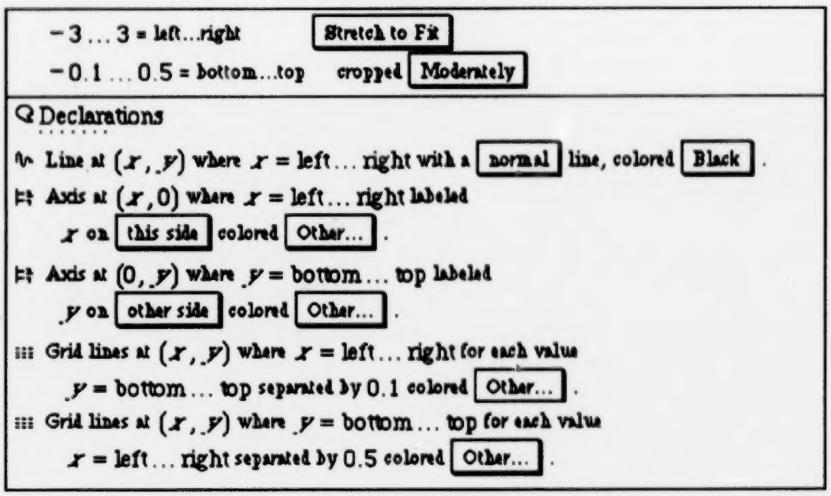
- Enter y =
- Use the fraction template tool to create a fraction.
- Enter the numerator 1. Select the denominator and select the
- square root template.
- Enter 2 and π (option p, of course).
- Select the entire fraction and choose the product template tool.
- Enter *e*. To enter an exponent begin it with ^.

Select the statement and select **Graph:y = f(x):Linear** . A graph will be created. By selecting the box which is darkened in the figure (labeled "Open graph parameters window") you will see the parameters which describe the graph's appearance.



Change the settings to those shown in the graph parameters window (next page). Note in particular the changes which must be made to the axis settings to get the x and y axes where we expect them.

Graph Parameters Window


−3 ... 3 = left...right
Stretch to Fit
−0.1 ... 0.5 = bottom...top
cropped
Moderately
Declarations
Line at (x, y) where x = left... right with a normal line, colored Black .
Axis at (x, 0) where x = left... right labeled
x on this side colored Other... .
Axis at (0, y) where y = bottom... top labeled
y on other side colored Other... .
Grid lines at (x, y) where x = left... right for each value
y = bottom... top separated by 0.1 colored Other... .
Grid lines at (x, y) where y = bottom... top for each value
x = left... right separated by 0.5 colored Other... .

Assuming that you will be using an object oriented art program (Canvas, DeskDraw, MacDraw, Superpaint in Draw mode are examples) the **Prefs:Graph...** menu should be used to turn off copying as a bit-map.

To use the graph in a Word document it must be copied as a graphic. Select where shown in the graph above and use **Edit:Copy as Pict**. Then paste into an object oriented graph program and massage as desired. In particular you will want to move the *x*- and *y*-axis labels and delete the 0 labels. You may want to add other text as described in part
IV of this document.

By the way the mathematical expressions in Theorist look pretty good if copied with **Edit:Copy as Pict** and pasted into Word.

Some fun – the following Theorist expressions suggest other things you can do with Theorist and similar symbolic algebra programs.

$$\triangle\ x^2 - 3x - 5 = \left(x + \frac{1}{2}\sqrt{29} - \frac{3}{2}\right)\left(x - \frac{1}{2}\sqrt{29} - \frac{3}{2}\right)$$

$$\triangle\ \sin^{-1}\left(\frac{1}{2}\right) = \frac{1}{6}\pi$$

$$\triangle \begin{pmatrix} 1 & \frac{1}{2} & 3 & -2 \\ 5 & 0 & -1 & 0 \\ \frac{2}{3} & 1 & 0 & 2 \\ 2 & \frac{1}{3} & 2 & 0 \end{pmatrix}^{-1} = \begin{pmatrix} -\frac{3}{112} & \frac{9}{56} & -\frac{3}{112} & \frac{27}{224} \\ \frac{27}{28} & \frac{3}{14} & \frac{27}{28} & -\frac{75}{56} \\ -\frac{15}{112} & -\frac{11}{56} & -\frac{15}{112} & \frac{135}{224} \\ -\frac{53}{112} & -\frac{9}{56} & \frac{3}{112} & \frac{141}{224} \end{pmatrix}$$

$$\odot f(x) = \frac{1}{\sqrt{2\pi}}\left(\int_0^x e^{-\frac{t^2}{2}}\, dt\right)$$

To enter *dt* you must have the cursor after the expression $e^{-\frac{t^2}{2}}$ and then enter d * t.

$\square f(1)$

$\triangle f(1) = 0.3413447459618402044$

VIII System Configurations

Fonts

New York is supposed to be the ImageWriter version of Times, but it lacks several important characters. The following Times characters, among others, do not exist in New York: π ≈ ≠ ±. They are available in the Symbol font and they are also in the Beverly Hills font, a shareware product which is a good font for the ImageWriter and other dot matrix printers.

Basic Fonts	
ImageWriter	LaserWriter
Beverly Hills	Times
Symbol	Symbol

I would suggest that those symbols which do not agree with the Times font be obtained from the Symbol font since Symbol is used for dot matrix and laser printers. Beverly Hills will minimize this problem. If Beverly Hills is defined as the normal font for a document created for an ImageWriter, then the normal font for that document can be converted to Times for a laser printer with a minimal impact (pun intended).

Bottom Line: Use Times for laser printers and TrueType printers. Use Beverly Hills for ImageWriters when not using TrueType. This is most likely to be the case on older machines and printers. Use the Symbol font anytime.

The following shows where the times and Beverly Hills fonts differ. Except for the ± symbol I would not use any Beverly Hills symbol in the shaded cell.

The Times Font (12 point)	
1 2 3 4 5 6 7 8 9 0 – = q w e r t y u i o p [ ] a s d f g h j k l ; ' z x c v b n m , . / ` \	! @ # $ % ^ & * ( ) - + Q W E R T Y U I O P { } A S D F G H J K L : " Z X C V B N M < > ? |
¡ ™ £ ¢ ∞ § ¶ • ª º – ≠ œ ∑ ´ ® † ¥ ¨ ^ ø π " ' å ß ∂ ƒ © ˙ ∆ ˚ ¬ … æ Ω ≈ ç √ ∫ ~ µ ≤ ≥ ÷ ` «	/ ¤ ‹ › fi fl ‡ ° · , — ± Œ „ ‰ Â Ê Á Ë È Ø ∏ ” ’ Å Í Î Ï Ì Ó Ô Ò Ú Æ Û Ù Ç ◊ ı ˆ ˜ ¯ ˘ ¿ Ÿ »

The Beverly Hills Font (12 point)	
1 2 3 4 5 6 7 8 9 0 - = q w e r t y u i o p [ ] a s d f g h j k l ; ' z x c v b n m , . / ` \	! @ # $ % ^ & * ( ) - + Q W E R T Y U I O P { } A S D F G H J K L : " Z X C V B N M < > ? |
¡ ™ £ ¢ ∞ § ¶ • ª º - ≠ œ Σ ´ ® ' ¥ ¨ ^ ø π " ' å β δ ∫ © Δ ¬ … æ Ω ≈ ç √ ∫ ~ µ ≤ ≥ ÷ ` «	1 2 3 4 5 6 7 8 9 0 — ± 1 2 3 4 5 6 7 8 9 Ø ∏ " ' Å ↑ → ⊕ ∴ ♠ Œ Æ ← ↓ Ç ◊ × ¿ »

Hardware/Software More discussion of the hardware you need was on page 3.

A hard disk drive is absolutely necessary. Buy at least 80-100 MB. The table whows what you might expect to be able to use given the amount of RAM installed in your computer.

RAM	Environment	Word Processor	Art	Grapher
1mb	Finder	Word	DeskDraw	GraphToolz
4 mb	MultiFinder	Word	DeskDraw	Theorist
6 mb+	MultiFinder	Word	Canvas or SuperPaint	Theorist

Most software vendors give educational discounts either directly or through a college bookstore. I bought Theorist for $139 through my college bookstore when the street price was about $240 and list was about $340. GraphToolz is shareware — a real bargain for $10.

Products mentioned in this document
Word 5.1: Word processor; Microsoft Corporation
DeskDraw: Draw-type art desk accessory by Zedcorp
Canvas: Draw-type art program by Deneba Software
SuperPaint: Draw-type art program by Aldus Corporation
MacDraw: Draw-type art program by Claris
Maple: Symbolic algebra program by Waterloo Maple Software.
Mathematica: Symbolic algebra program by Wolfram Research
Theorist: Symbolic algebra program by Prescience Corporation
GraphToolz: Function graphing program; shareware
Beverly Hills: Font; shareware